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CORRELATION OF INERTIAL CAVITATION THRESHOLD WITH THROMBOLYSIS EFFICACY WHEN UTILIZING DIAGNOTIC ULTRASOUND GUIDED HIGH MECHANICAL INDEX IMPULSES AND MICROBUBBLES

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Background: The exact mechanism whereby high mechanical index (MI) impulses from a diagnostic ultrasound (DU) transducer dissolve thrombi in the presence of microbubbles (MB) is unknown. Cavitation is the presumptive mechanism, but two forms exist: a stable form (SC) induced at a lower MI which creates increased shear stress, and an inertial form (IC) induced at a higher MI which creates fluid jets. The purpose of this study was to examine the role of these different forms of cavitation in dissolving thrombi in the presence of MB.

Methods: A flow system with a 5 cm tissue-mimicking phantom was constructed through which a DU transducer imaged a total of 72 porcine arterial thrombi (age three hours) exposed to intermittent high MI impulses (range 0.0-1.4) during a dilute lipid-encapsulated microbubble (0.5% Definity) infusion. Twelve different MI's were tested. Pulse duration was 5 μsec, frequency 1.6 Megahertz. Cavitation signals (CS) were obtained during treatments with two confocal passive cavitation detectors. Percent thrombus dissolution (%TD) was compared between groups and correlated to CS.

Results: %TD increased significantly at a threshold MI higher than 0.8 ($p = 0.0014$ compared to 0.2 MI) but no further dissolution occurred by going beyond 0.8 MI (Figure 1A). IC became dominant at 0.7 MI (Figure 1B). At MI<0.7 where SC was dominant, minimal thrombus dissolution occurred.

Conclusion: Achieving significant TD with aged thrombi is closely correlated with induction of dominant IC states.